

SUMMARY

PURPOSE AND NEED

Golden Sunlight Mines, Inc. (GSM) conducts open pit mining and mineral processing on private and public lands under Operating Permit No. 00065, issued by the Montana Department of Environmental Quality (DEQ) in 1972, and Plan of Operations #MTM82855, issued by the Bureau of Land Management (BLM) in 1982. A major mine expansion permitted in 1998 was challenged in the Montana First Judicial District Court (District Court). The District Court ruled, based on the record before the court, that GSM's reclamation plan must include backfilling the pit and ordered DEQ to implement partial pit backfilling in accordance with the procedures of the Metal Mine Reclamation Act (MMRA). BLM notified DEQ that backfilling the pit may result in "unnecessary or undue degradation of public lands" and that BLM must prepare a supplemental review pursuant to the National Environmental Policy Act (NEPA) and approve the modification to the reclamation plan. On October 24, 2002, DEQ, acting pursuant to the June 27, 2002, District Court judgment, ordered GSM to submit a modified partial pit backfill plan. The plan was to take into consideration current conditions at the mine site and address compliance with the Montana Water Quality Act. GSM submitted a proposed partial pit backfill plan on December 2, 2002. The purpose and need for action is to determine the mine pit reclamation plan to meet the requirements of MMRA and the Water Quality Act. The Supplemental Environmental Impact Statement (SEIS) evaluates the potential impacts of the backfill plan and alternatives pursuant to NEPA and the Montana Environmental Policy Act (MEPA).

What has changed in the Summary since the DSEIS?

The Summary provides a synopsis of the entire SEIS. Based on additional data and public comments, the following changes have been made:

- The overall groundwater capture needed from two dewatering well systems to meet groundwater standards at the mixing zone boundary for the Partial Pit Backfill With Downgradient Collection Alternative was changed from 95% to 96% capture efficiency.
- The volumes of soil cover needed in the four alternatives were updated.
- The pit discharge rate was changed from 16 gpm to between 27 and 42 gpm for the Partial Pit Backfill With Downgradient Collection Alternative and from 32 gpm to between 25 and 27 gpm for the No Pit Pond and Underground Sump alternatives.
- The groundwater collection and treatment rate was changed from 121 to 79 to 145 gpm for the Partial Pit Backfill With Downgradient Collection Alternative.
- All text, figures and tables were revised from data provided by GSM and various consultants.
- Text was corrected based on references.

ISSUES

A Notice of Intent (NOI) to prepare the SEIS was published in the Federal Register on May 7, 2003. The NOI invited scoping comments to be sent to DEQ and BLM through June 7, 2003. On July 1, 2003, a press release was issued to area newspapers, State of Montana Newslinks Service, and major interest groups. A public scoping meeting was held near the mine in Whitehall, Montana, on July 16, 2003.

Technical Issues

Technical issues for final mine pit reclamation include the design and constructability of the alternatives, pit highwall stability and maintenance, backfill maintenance, the effects of subsidence in the underground workings, operational and maintenance requirements of the groundwater/effluent management system, storm water management maintenance requirements, soil cover maintenance requirements, water treatment plant operating and sludge management requirements, and the flexibility of the alternative for implementing new technologies in the future.

Environmental Issues

Environmental issues for final mine pit reclamation include impacts to groundwater quality and quantity, the risk of violation of groundwater quality standards and impairment of beneficial uses of the Jefferson River alluvial aquifer, impacts to surface water quality and quantity, the risk of violation of surface water quality standards and impairment of beneficial uses of the Jefferson River and Slough, surface disturbance, hazards to wildlife, and the amount of disturbed land left unvegetated.

Socioeconomic Issues

Socioeconomic issues include worker and public safety, mining and reclamation employment, tax revenue, access to future mineral reserves and resources, land use after mining, aesthetics, and the future burdens on society and GSM.

Project Economics Issues

Project economics issues include the costs of reclamation.

ALTERNATIVES ANALYZED IN DETAIL

No Pit Pond Alternative (No Action)

Under the No Pit Pond Alternative, the bottom 100 feet of the pit would be backfilled with crusher reject waste rock to create a backfill sump. The backfill would serve as a

flat working surface on which to station two to three dewatering wells and other components of a collection system. The dewatering system would collect water in the sump and pump it to a permanent water treatment plant. By maintaining the groundwater level as low as possible in the crusher reject, no water would be allowed to pond in the pit bottom. Protection for the pumping facilities and workers would be provided by building one or more berms around the perimeter of the 1.3-acre working area to trap rocks that might fall from the pit highwall. A 3-foot soil cover system would be placed over the crusher reject.

Partial Pit Backfill With In-Pit Collection Alternative (Proposed Action)

Under this alternative, the pit would be backfilled with 100 feet of crusher reject and then waste rock from the East Waste Rock Dump Complex to create a free-draining surface at the 5,350-foot elevation. The upper pit highwall would be cast blasted and contoured to 2H:1V slopes. A 3-foot soil cover system would be placed over the graded area and revegetated. Eleven dewatering wells would be installed through the backfill to bedrock to maintain the pit as a hydrologic sink, and the water would be pumped to a permanent water treatment plant.

Partial Pit Backfill With Downgradient Collection Alternative

This alternative is a variation of the Partial Pit Backfill With In-Pit Collection Alternative. The pit would be backfilled, and the pit highwall would be reduced, as in the Partial Pit Backfill With In-Pit Collection Alternative. The pit would not be maintained as a hydrologic sink by installing wells inside the backfilled area. Instead, a system of wells would be operated outside of and down gradient from the pit to intercept contaminated groundwater after it has left the pit. The system would include an estimated 31 or more new downgradient capture wells, existing wells in the Tailings Impoundment No. 1 capture and monitoring system, and 10 new monitoring wells.

Underground Sump Alternative

The Underground Sump Alternative is similar to the No Pit Pond Alternative, except no backfill would be placed in the pit, and the underground workings would be improved and maintained as a sump for pit dewatering.

ALTERNATIVES CONSIDERED AND DISMISSED FROM DETAILED ANALYSIS

Partial Pit Backfill Without Collection Alternative

The Partial Pit Backfill Without Collection Alternative was developed to evaluate the possibility of avoiding long-term pit water collection and treatment. Reclamation would be the same as under the Partial Pit Backfill With In-Pit Collection Alternative and the Partial Pit Backfill With Downgradient Collection Alternative; however, wells would not

be installed. Natural attenuation and mixing of contaminated pit groundwater with ambient groundwater would be relied on to meet groundwater quality standards at the mixing zone boundary. This alternative was not considered in detail because compliance with groundwater quality standards could not be reliably assured without downgradient or in-pit collection of contaminated groundwater. It would not meet the purpose and need.

Partial Pit Backfill With Amendment Alternative

The Partial Pit Backfill With Amendment Alternative was developed to try to avoid the need for long-term pit water collection and treatment. Reclamation would be the same as under the Partial Pit Backfill With In-Pit Collection and Partial Pit Backfill With Downgradient Collection alternatives, except lime would be added to the waste rock to increase the pH of the water that would collect in the backfill. This alternative was not considered in detail because analysis indicated that without downgradient groundwater capture, compliance with groundwater quality standards for arsenic, selenium, sulfate, and zinc could not be reliably assured. It would not meet the purpose and need.

Pit Pond Alternative

The possibility of creating a pit pond with biologic treatment was analyzed. The objective would be to design a pond that could sustain aquatic life and provide beneficial uses once it was developed. In the Pit Pond Alternative, the pit would be allowed to fill with precipitation, groundwater, and runoff water. The water would be treated in the pit with microbes, nutrients, etc. This alternative would have no clear advantage over the Underground Sump Alternative. Without further technical review, any pond concept could only be considered by the agencies on a trial basis. Consequently, this alternative was dismissed. It would not meet the purpose and need.

SUMMARY OF IMPACTS

Table 1 summarizes and compares the impacts of each alternative considered.

MITIGATION MEASURES

Mitigation measures for the mining operations at GSM were identified in the 1997 Draft EIS, Chapter IV, Section IV.P. Only mitigation and monitoring that could be implemented to mitigate potential impacts from the pit reclamation alternatives being evaluated in this SEIS. These twenty-three measures are presented in this SEIS in Chapter 4, Section 4.8.

PREFERRED ALTERNATIVE

The rules and regulations implementing MEPA and NEPA (ARM 17.4.617 and 40 CFR 1502.14, respectively) require that the agencies indicate a preferred alternative in the Draft SEIS, if any, and in the Final SEIS prepared for the project. The preferred alternative is not a final decision; it is an indication of the agencies' preference at this time. The final decision will be made in the Record of Decision that will be prepared no sooner than 30 days after the Notice of Availability of the Final SEIS is published in the Federal Register. The agencies' preference considers all information that has been received and reviewed relevant to the proposed project, and all comments received on the Draft SEIS. The preferred alternative at this time is the Underground Sump Alternative with visual and other mitigations described in Section 4.8.3.2.

Rationale for the Preferred Alternative

Under all alternatives, the probability of highwall failure is low, and there would be no threats to public safety or the environment outside the pit. Some wildlife habitat would be provided. However, only the Underground Sump and No Pit Pond alternatives provide adequate assurance that pollution of the Jefferson River in violation of water quality laws would not occur. These alternatives would provide sufficient control of pit seepage through evaporation and collection. Sufficient control of pit seepage to protect groundwater and surface water quality cannot be reliably assured under the other alternatives because of the problems associated with drilling and operating wells in the 875 feet of reactive backfill and with effectively capturing seepage in or down gradient of the pit.

With the imposition of the visual mitigations described in Section 4.8.3.2 of the Draft SEIS, the Underground Sump and No Pit Pond alternatives also mitigate post-reclamation visual contrasts between the pit and adjacent lands.

The Underground Sump Alternative would pose less risk to workers monitoring and operating the water capture system from rock raveling from the highwall than would the No Pit Pond Alternative. Under the No Pit Pond Alternative, the workers would perform these functions while exposed to raveling and sloughing from a 1,775-foot highwall. Under the Underground Sump Alternative, much of the work would be performed underground. In addition, the Underground Sump Alternative would require less maintenance than the No Pit Pond Alternative, because the most of the collection system would not be susceptible to damage from rock raveling from the highwall.

BLM is mandated by the Federal Land Policy and Management Act (PL 94-579) and subsequent 43 CFR 3809 surface management regulations to manage federal lands so as to prevent unnecessary or undue degradation of the public lands. The preferred alternative prevents unnecessary or undue degradation of the land by maximizing the amount of mine impacted water collected and treated, limiting the potential for mine impacted water to escape collection, and limiting the potential for water quality violations at the mixing zone boundary.

Table S - 1. Summary Comparison of Impacts Under the Proposed Action and Alternatives

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Technical Issues				
Design & constructability of the alternative <i>Proven design</i>	Backfilling with 111,000 cubic yards of crusher reject to a depth of 100 feet is a proven design. Dewatering this volume of material to a depth of 100 feet is a proven design.	Backfilling with 33 million cubic yards of acidic waste rock and cast blasting and dozing the highwall to a 2H:1V slope is technically feasible. Dewatering waste rock backfill from a depth of up to 875 feet has not been proven.	Similar to Partial Pit Backfill With In-Pit Collection Alternative. Pumping out of downgradient drainages in natural geologic formations up to 200 feet deep is done regularly, but the objective of overall 96 percent capture may not be achievable.	Not applicable. Maintaining hydrologic connection between the pit bottom and an underground sump 25 to 75 feet below the pit and pumping from the sump have been done successfully at GSM and other mines.
Design & constructability of the alternative <i>Ability to construct the alternative at GSM</i>	Problems with constructing this alternative would be minimal.	There would be more problems developing and implementing this alternative than the No Pit Pond Alternative because of the larger volume and depth of backfill needed, the amount of cast blasted material, and the problems drilling dewatering wells in up to 875	There would be more problems developing and implementing this alternative than the No Pit Pond Alternative because of the larger volume and depth of acidic backfill needed and the amount of cast blasted material required. Installing dewatering wells in downgradient drainages in natural geologic	GSM has developed and maintained an underground mine, including an underground sump connected to the open pit.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
		feet of unconsolidated waste rock in order to maintain the pit as a hydrologic sink.	formations up to 200 feet deep has been done successfully at GSM.	
Pit highwall				
<i>Pit highwall stability</i>	Some portions of the pit highwall would be subject to raveling, talus formation, erosion, and limited sloughing. The overall stability of the pit highwall would be expected to increase over the long term as the rock materials achieve a more stable configuration.	No pit highwall would remain exposed. Backfilling the pit would eliminate pit highwall raveling and sloughing. Cast blasting would enhance the inherent stability of the pit highwall by reducing the slope to 2H:1V. The long-term stability of the pit highwall would be greater than the No Pit Pond Alternative.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Similar to the No Pit Pond Alternative.
<i>Pit highwall maintenance requirements</i>	Raveling and sloughing of the highwall would require periodic maintenance to re-establish the 5,700-foot-elevation safety bench, clear the access road, haul more backfill to create a new working surface in the pit bottom, and move rock to re-establish safety berms. This could occur more than once over the long term.	No highwall maintenance would be needed.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Similar to the No Pit Pond Alternative. Depending on the location of highwall raveling and sloughing, access to the 4,550-foot portal and the underground dewatering system could be lost. The 5,700-foot safety bench and access to the 4,550-foot portal would have to be re-established.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Backfill				
Backfill maintenance requirements	Settling in 100 feet of crusher reject would be limited to 10 feet. Repairs would be needed to bring the crusher reject back to grade.	Up to 150 feet of settling could occur in the 875 feet of backfill, with 60 to 75 percent of the settling occurring during the backfilling operation. Repairs would be needed to bring the acidic backfill back to grade. Settling in the acidic backfill would affect storm water diversions on the 2H:1V slopes.	Up to 200 feet of settling could occur in the 875 feet of backfill after it is inundated with groundwater. Sixty to seventy-five percent of settling would occur during the backfilling operation. The remaining settling would occur over about 61 years during saturation to the 5,260-foot elevation. Repairs would be needed to bring the backfill back to grade. Settling in the backfill would affect storm water diversions on the 2H:1V slopes.	Not applicable.
Underground workings	Raveling and sloughing of the highwall would require periodic maintenance to re-establish the working surface and drill new wells.	The highwall would not ravel or slough.	The highwall would not ravel or slough.	Not applicable.
Impacts to pit facilities due to subsidence related to underground mining	Localized failures of the walls and ceiling over time could result in subsidence, especially in seep and fault areas where chemical weathering would be increased. Subsidence could cause settling in the 100 feet of crusher reject, affecting the dewatering wells in the crusher reject.	Same as the No Pit Pond Alternative. Subsidence could cause settling in up to 875 feet of backfill, affecting the dewatering wells in the backfill.	Similar to the Partial Pit Backfill With In-Pit Collection Alternative, except the dewatering wells down gradient of the pit would not be affected.	Same as the No Pit Pond Alternative, except localized failures of ceiling and walls in seep and fault areas could occur over time, affecting access to the dewatering system in the underground workings.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Groundwater/ effluent management system				
Operation requirements (number of wells)	Two to three wells would be constructed through the acidic pit crusher reject about 100 feet deep to the bedrock contact.	Eleven wells would be constructed through the acidic pit backfill up to 875 feet deep to the bedrock contact. Wells would need to be replaced frequently due to corrosion.	An additional 31 capture wells and 10 monitoring wells would be constructed down gradient from the pit. This number of wells may not be enough to ensure compliance with groundwater quality standards at the mixing zone boundary.	No wells would be constructed. Drill holes would be used to direct pit water to the underground sump.
Maintenance of capture points	Settlement of the 100 feet of crusher reject could cause separation, buckling, or shearing of well casings. About 60 to 75 percent of settlement would occur during the backfill operation and 25 to 40 percent over a longer period after backfilling is complete. Corrosion of the well casings, pumps, electrical components, monitoring equipment and pipelines from the acidic water in the backfill would cause periodic need for repair and replacement of dewatering system components.	Settlement effects on well casings would be more severe than under the No Pit Pond Alternative. Same as the No Pit Pond Alternative.	Wells would be constructed outside of the pit and would not be subject to acidic backfill settling. Short-term buffering by the aquifer and mixing with ambient groundwater would limit corrosion of pumps and screens, providing for longer pump life. After the buffering capacity of the aquifer is used up in a few tens of years, water quality would be similar to the No Pit Pond and Partial Pit Backfill With In-Pit Collection alternatives.	There would be no backfill to settle and no wells to damage. Rock fall from ceiling and walls of the underground workings could damage the dewatering system. Corrosion would be similar to the No Pit Pond Alternative.
	Highwall raveling and	Not applicable.	Not applicable.	Similar to the No Pit Pond

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
	sloughing could damage dewatering wells, monitoring equipment, powerlines, and pipelines. Pumping rates of 25 to 27 gpm at a lift of up to 200 feet would not be a problem. Pumping stations would be used to finish getting the water out of the pit. Not applicable.	Lower pumping rates and the 875-foot lift compared to the No Pit Pond Alternative would cause more pump failure and may cause the need to allow the water table to rebound for pumping efficiency. No pumping stations would be needed. Not applicable.	Similar to the No Pit Pond Alternative. Multiple wells up to 200 feet deep would pump a total of 79 to 145 gpm. Not applicable.	Alternative, except the collection system would not be damaged as much. Similar to the No Pit Pond Alternative, except the lift would increase by 75 feet. Access to the underground would be needed. Sloughing could bury the 4,550-foot elevation portal blocking access to the dewatering system needed for maintenance.
Storm water runoff/runoff management <i>Maintenance requirements (drainage channels off 2H:1V slopes)</i>	Diversions on the upper pit highwall would route water away from the pit. Settling of diversions constructed on unconsolidated materials and accumulations of sediment and material sloughed from above would impair diversions' function. Periodic cleaning and	Same as the No Pit Pond Alternative, except there would be diversions on the pit backfill.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
	repairs would be needed. Eventually, portions of the diversions would need to be reconstructed completely. Not applicable.	Diversions would be constructed on the 2H:1V slopes created by highwall reduction. Settling in the backfill could cause depressions where surface water could accumulate, infiltrate, and saturate the soil cover resulting in erosion on the face of the reclaimed slopes. Maintenance requirements for diversions would be the same as for the No Pit Pond Alternative, except there would be more diversions to maintain.	Maintenance requirements would be similar to the Partial Pit Backfill With In-Pit Collection Alternative. More settlement would occur due to saturation of the backfill.	Not applicable.
Soil cover				
Soil cover maintenance requirements (erosion, revegetation)	A 3-foot soil cover would be placed and revegetated on the pit floor, pit benches, and roads, totaling 53 acres. A total of 290,400 cubic yards of soil cover material, from existing sources, would be necessary. Eroded areas would need to be repaired, resilled, and reseeded. Noxious	A 3-foot soil cover would be placed and revegetated on the backfilled pit and reduced highwall, totaling 272 acres. A total of 1,541,800 cubic yards of soil cover material, resulting in an additional disturbance of 31 acres, would be necessary. Same as the No Pit Pond Alternative.	Similar to the Partial Pit Backfill With In-Pit Collection Alternative. Same as the No Pit Pond Alternative.	Similar to the No Pit Pond Alternative, except there would be 1.3 fewer acres to maintain in the pit. A total of 285,600 cubic yards of soil cover material, from existing sources, would be necessary. Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
	weeds would have to be controlled. The backfill surface would need to be regraded as the crusher reject settles. Rocks that ravel or slough from the highwall onto revegetated areas would need to be removed. Depending on the volume of rock, releveling with more fill, regrading, reseedling, and reseedling of reclaimed surfaces may be needed.	Backfill would settle up to 150 feet. More acidic backfill would have to be placed, graded, reseeded, and revegetated.	Backfill would settle up to 200 feet.	There would be no backfill needing cover maintenance.
	In localized areas, highwall seeps could saturate the soil cover with acidic water, contaminating soils and impairing revegetation success. The seep would have to be located and dewatered, contaminated soil would have to be replaced with clean soil, and the area would have to be revegetated.	Same as the No Pit Pond Alternative.	Same as the No Pit Pond Alternative.	Same as the No Pit Pond Alternative.
Water treatment	Between 25 and 27 gpm of pit water would need treatment.	Between 27 and 42 gpm of pit water would need treatment.	Between 79 and 145 gpm of groundwater would be collected and treated trying to capture 96 percent of the 27 to 42 gpm of pit discharge to meet water quality standards.	Same as the No Pit Pond Alternative.
Additional sludge management requirements				

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
	<p>The sludge management requirements would be similar to or less than estimated in the 1997 Draft EIS.</p>	<p>Weathering would continue to produce oxidation byproducts in the unsaturated backfill. Pumping would limit saturation of the backfill and impacts from jarosite dissolution. More sludge would be produced per gallon of treated water than under the No Pit Pond Alternative, so sludge management requirements would be similar to those estimated in the 1997 Draft EIS.</p>	<p>Weathering would continue to produce oxidation byproducts in the unsaturated backfill. Jarosite in the saturated portion of the backfill would, for a time, prevent reducing conditions from developing and allow further production of acid. Jarosite is stable under oxidizing conditions and unstable under reducing conditions. The presence of jarosite in the pit backfill would only influence the redox conditions until it all dissolves. Jarosite would likely dissolve and release metals in the saturated portion of the backfill. Once jarosite completely dissolves, reducing conditions would likely develop in the saturated portion of the backfill. The flow from the unsaturated portion of the backfill above the water table would contribute low pH water with high metals concentrations to the pit discharge for hundreds of years. There is limited natural attenuation capacity along the primary and secondary flow paths from the pit. The sludge management requirements would be about the same as the Partial Pit Backfill With In-</p>	<p>The water produced in the underground workings would be comparable to the water quality in the No Pit Pond Alternative. Because there would be no backfill, jarosite, adsorbed metals, and other oxidation byproducts would remain relatively immobile in the waste rock dump complex. There would be minimal additional sludge.</p>

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
<i>Additional operating requirements</i>	There would be no additional water treatment operating requirements. The water treatment system in the SEIS is the same as that evaluated in the 1997 Draft EIS, and there would be less pit water to treat.	Same as the No Pit Pond Alternative.	Pit Collection Alternative because the chemical mass would be about the same. The water treatment plant could require additional operating cost due to the increased water quantity treated under this alternative. The total amount of water would be less than the permitted treatment plant capacity.	Same as the No Pit Pond Alternative.
<i>Flexibility for future improvements</i>				
<i>Potential for utilization of new technologies</i>	New technology, such as <i>in-situ</i> water treatment, would be easier to apply in the less than 600,000 cubic yards of crusher reject and raveled and sloughed highwall rock under the No Pit Pond Alternative than it would be in the larger volumes of backfill under the partial pit backfill alternatives.	New technology, such as <i>in-situ</i> water treatment, would be harder to apply in 47 million cubic yards of pit backfill than under the No Pit Pond Alternative. Because of the problems with maintaining wells in acidic waste rock in the deeper backfill, this alternative offers less potential for utilization of new technologies. It would be harder to redesign the dewatering system in up to 875 feet of backfill.	Similar to the Partial Pit Backfill With In-Pit Collection Alternative, except that <i>in-situ</i> water treatment would be more difficult because of the lack of wells in the backfill. If treatment were attempted outside of the pit, a dispersed plume may be more challenging to track, contain, and treat <i>in-situ</i> .	New technology, such as <i>in-situ</i> water treatment, would be easier to apply in the open water of an underground sump than in backfill.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Environmental Issues				
Impacts to groundwater quality and quantity				
<i>Risk of impacts to groundwater quality and quantity in permit area</i>	<p>The pit would be maintained as a hydrologic sink and between 25 and 27 gpm of pit water would be collected and treated before being discharged. No impacts to groundwater quality from pit outflows are expected.</p> <p>The groundwater level around the pit would be permanently drawn down. This would result in minor reductions in the flows of springs that are hydrologically connected to the pit.</p>	<p>Same as the No Pit Pond Alternative, except 27 to 42 gpm would be collected and treated.</p> <p>Same as the No Pit Pond Alternative.</p>	<p>The pit would not be a hydrologic sink. Two groundwater capture systems in Rattlesnake Gulch, each operating at an efficiency of 87.5 percent or greater would be required to meet DEQ-7 water quality standards at the mixing zone boundary for the toxic and carcinogenic parameters modeled. The groundwater standard for iron would be exceeded. This level of capture efficiency may not be achievable. Based on their experience, the agencies believe a maximum capture efficiency of 80% per system is potentially achievable.</p> <p>The groundwater level around the pit would rebound so that the flows of springs that are hydrologically connected to the pit could be increased.</p> <p>Because of the higher pit groundwater elevation, ARD water from the pit could move along secondary flow paths in</p>	<p>Same as the No Pit Pond Alternative, except that water would be pumped from the underground sump and treated.</p> <p>Same as the No Pit Pond Alternative.</p>

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
			<p>the bedrock and Bozeman Group aquifers where it is more difficult to detect and collect.</p> <p>Groundwater quality would likely be degraded up gradient of the collection wells where groundwater is already affected by ARD from natural mineralization and may eventually be impacted from a small portion of the East Waste Rock Dump Complex.</p> <p>The potential for creating new springs or affecting water quality of existing springs is higher than under the other alternatives.</p>	

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
<i>Risk of violation of groundwater standards at permit boundary and impacts to beneficial uses of the Jefferson River alluvial aquifer</i>	Groundwater quality standards would be met at the mixing zone boundary. Beneficial uses of the Jefferson River alluvial aquifer would not be affected.	Compliance with water quality standards at the mixing zone boundary may not be achievable.	Two groundwater capture systems in Rattlesnake Gulch, each operating at an efficiency of 87.5 percent or greater would be required to meet DEQ-7 human health standards at the mixing zone boundary for the toxic and carcinogenic parameters modeled. The DEQ-7 standard for iron would be exceeded. The required capture efficiency may not be achievable. Based on their experience, the agencies believe a maximum capture efficiency of 80% per system is potentially achievable. With two systems each operating at 80 percent capture efficiency, DEQ-7 human health water quality standards for nickel, and copper would be exceeded at the permit boundary and within the Jefferson River alluvial aquifer. Nondegradation criteria for groundwater quality in the JRA aquifer fail for arsenic, cadmium, copper, iron and nickel at all levels of groundwater capture efficiencies modeled, up to and including 96% combined capture efficiency.	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Impacts to surface water quality and quantity				
Impacts to springs, wetlands	The groundwater level around the pit would be permanently drawn down resulting in minor reductions in the flows of springs that are hydrologically connected to the pit.	Same as the No Pit Pond Alternative.	The groundwater level around the pit would rebound so that the flows of springs that are hydrologically connected to the pit would remain the same or increase. New springs or seeps could be created that would be impacted by ARD from the pit. Discharges of ARD at existing springs around the pit area could increase.	Same as the No Pit Pond Alternative.
Risk of violation of surface water standards and impacts to beneficial uses of the Jefferson River and Slough	There would be no pit discharge. There would be no risk of violation of surface water standards and impacts to beneficial uses in the Jefferson River and Slough.	Same as the No Pit Pond Alternative.	The risk of contaminants reaching the Jefferson River or Slough and affecting surface water quality and beneficial uses is greater than for alternatives that maintain the pit as a hydrologic sink. Two groundwater capture systems in Rattlesnake Gulch, each operating at an efficiency of 87.5 percent or greater would be required to meet DEQ-7 surface water quality standards. At this capture efficiency, the chronic aquatic life standards were met in the Jefferson River Slough for the parameters modeled. Based on their experience, the agencies believe a maximum capture efficiency of 80% per	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
			<p>system is potentially achievable. At this efficiency, the chronic aquatic life standard for aluminum would be exceeded in the Jefferson River Slough over the entire predicted range.</p> <p>Nondegradation criteria for surface water quality in the Slough fail for aluminum, copper and iron at all levels of groundwater capture efficiencies modeled, up to and including 96% combined capture efficiency.</p> <p>Control of pit seepage along secondary pathways may be difficult. There is little attenuation capacity in the Tertiary debris flow/colluvial aquifer.</p>	
Reclamation plan changes				
Surface disturbance	No new pit disturbance.	56 acres of new pit disturbance and 31 acres of new soil salvage disturbance.	Same as the Partial Pit Backfill With In-Pit Collection Alternative, except 2 additional acres would be disturbed for downgradient wells.	Same as the No Pit Pond Alternative.
Hazards to wildlife	There would be no additional hazards to wildlife.	There would be fewer hazards to wildlife than under the No Pit Pond Alternative because the highwall would be eliminated.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Total remaining unvegetated acres	158 acres	2 acres of access roads	2 acres of access roads	159 acres
Socioeconomic Issues				
Safety				
<i>Risk to workers (reclamation and construction)</i>	The safety risk to reclamation workers would be increased while crusher reject is being hauled down the steep roads into the pit, because of the potential for truck accidents.	The safety risk to reclamation workers would be the same as under the No Pit Pond Alternative while 100 feet of crusher reject is being hauled down the steep roads into the pit. The rest of the backfilling would be by end dumping acidic waste rock from the pit rim, a standard method used during mining that has less risk than hauling loaded trucks to the bottom of the pit. Cast blasting and dozing to reduce the pit highwall would present risks to workers. Workers installing, operating, and maintaining the dewatering system would not be working below a highwall and would not be at risk of injury from rock falls.	Similar to the Partial Pit Backfill With In-Pit Collection, except separate placement of crusher reject in the bottom of the pit would not be required.	Less than the No Pit Pond Alternative. Backfill would not be hauled into the pit.
<i>Risk to workers (long-term maintenance)</i>	Workers would be below a highwall of up to 1,875 feet high with the risk of injury from rock falls.	Workers would not be exposed to the pit highwall raveling and sloughing. Long-term access would be needed to the bottom would not be	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Workers would be exposed to rock falls from the walls and ceiling of the underground workings as well as from the highwall. Overall risk would be less than the No Pit Pond Alternative.
	Workers in the pit would be exposed to the 1,775-foot pit highwall raveling and sloughing. Long-term access would be needed to the bottom would not be	Workers would not be exposed to pit highwall raveling and sloughing. Long-term access to the pit bottom would not be	Similar to the Partial Pit Backfill With In-Pit Collection Alternative.	Similar to the No Pit Pond Alternative, except workers would be exposed to rock falls from the walls and ceiling of the underground workings as

Summary

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
	the pit bottom for monitoring and maintenance of the pit haul road, the 5,700-foot elevation pit safety bench, and the dewatering system.	The risk to worker safety in this alternative would be less than the No Pit Pond Alternative and would be similar to the risk of work currently conducted on the waste rock dump complexes.		well as from the 1,875-foot highwall. Overall risk would be less than the No Pit Pond Alternative.
Risk to public safety	Access restrictions on general public use would be maintained and would consist of signs, berms, and fencing around the pit area, but there would still be a risk to public safety from the pit highwall.	Same as the No Pit Pond Alternative, except there would be no risk to public safety from the pit highwall.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.
Mining employment				
Potential employment from mining Stage 5B	750 person years	750 person years. Premature closure would reduce this by 150 person years per year.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.
Reclamation employment				
Reclamation employment opportunities	123 person years	308 person years	308 person years	124 person years
Revenue from taxes				
Potential tax revenues from mining Stage 5B	\$8,087,000	Same as the No Pit Pond Alternative, except premature closure would reduce this to \$60,000.	Same as the No Pit Pond Alternative, except that premature closure would reduce this tax revenue.	\$8,087,000
Potential tax revenues from pit backfill	\$319,500	\$806,000	\$911,000	\$322,000

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Mineral reserves and resources				
Access to future mineral reserves/ Resources	If the pit were to be enlarged for additional mining in the future, it would take 1.5 months to remove the 600,000 cubic yards of crusher reject, soil, and highwall rock. Time is based on the 2002 mining rate of 405,000 cubic yards per month. The pit would have to be dewatered before it could be enlarged. The additional time required to dewater the pit would be minimal.	If the pit were to be enlarged for additional mining in the future, it could take 116 months to remove the 47 million cubic yards of backfill and soil. The pit would have to be dewatered. The additional time required to dewater the pit would be the same as the No Pit Pond Alternative.	Same as the Partial Pit Backfill With In-Pit Collection Alternative. Because the water table would rebound, more of the acidic backfill would have to be dewatered as mining proceeded. The time required to dewater the pit would be longer than the Partial Pit Backfill With In-Pit Collection Alternative.	If the pit were to be enlarged for additional mining in the future, it would take 0.5 month to remove the 200,000 cubic yards of raveled and sloughed highwall rock and soil. Similar to the No Pit Pond Alternative.
Land use after mining Suitability of land use after mining	The land use after mining would be wildlife habitat. About 60 acres would be revegetated. About 158 acres of mule deer habitat would be lost. Limited raptor and bat habitat would be developed in the upper highwall.	The land use after mining would be wildlife habitat. About 272 acres would be revegetated. Up to 2 acres of habitat would be lost for access roads. Raptor and bat habitat would not be developed.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Aesthetics				
<i>Visual contrast with adjacent lands</i>	Portions of the highwalls and benches would remain visible. Overall visual contrasts would be reduced to a level where they are noticeable, but not dominant in the landscape, following successful reclamation and revegetation. Landscape modifications would be consistent with the suggested VRM Class III rating for the area.	The reclaimed 2H:1V slopes covering the pit highwall and the reclaimed slopes of the waste rock dump complexes would still be visible, but the overall contrasts would be reduced under this alternative.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.
Potential future burden on society				
<i>Potential future burden on society</i>	The consequence of failure of this alternative would be the creation of a pit pond below the 5,050-foot elevation. No impacts to groundwater and minimal impacts to springs would occur.	The consequence of failure of this alternative would be uncontrolled discharges of ARD-impacted groundwater from the backfilled pit, which could adversely impact springs and beneficial uses of the Jefferson River alluvial aquifer.	Same as the Partial Pit Backfill With In-Pit Collection Alternative.	Same as the No Pit Pond Alternative.

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
<i>Potential for future liabilities for GSM</i>	<p>No water would leave the pit. If the dewatering system failed, it could be re-established on the regraded pit bottom through 200 feet of crusher reject and sloughed highwall rock more easily than through up to 875 feet of acidic backfill. Continued safe access to the dewatering system for operation and maintenance would be more difficult than the partial pit backfill alternatives because of highwall rock raveling and sloughing onto safety benches and access roads.</p> <p>Removing water from 100 feet of crusher reject would not be a problem. Dewatering system components would fail regularly from crusher reject settling and corrosion.</p>	<p>No water would leave the pit. If the dewatering system failed, it could be re-established by drilling new wells. Drilling and maintaining wells in up to 875 feet of acidic backfill would be problematic. Safe access to the dewatering system for operation and maintenance would not be a problem because there would be no highwall.</p> <p>Removing water from up to 875 feet of acidic backfill would be difficult. Dewatering system components would fail more often than under the No Pit Pond Alternative.</p>	<p>The potential for water quality degradation outside of the pit would be increased. From 27 to 42 gpm of untreated water would escape the pit. If either of the two groundwater capture systems failed to achieve at least 87.5 percent efficiency, groundwater standards for nickel and copper would be exceeded at the edge of the mixing zone.</p> <p>The quality of the water collected down gradient of the pit would be partially attenuated and mixed with regional groundwater, but consistently achieving 87.5 percent capture for two pumping systems may not be achievable. Based on their experience, the agencies believe a maximum capture efficiency of 80% per system is potentially achievable. Dewatering system components would not fail as regularly due to settling and corrosion.</p>	<p>No water would leave the pit. Removing water from the underground sump would be easier than pumping out of waste rock backfill or crusher reject. If the dewatering system failed, it could be re-established more easily than under the partial pit backfill alternatives. Continued safe access to the dewatering system for operation and maintenance, because of wall and ceiling rock sloughing in the underground workings, would be less risky than the No Pit Pond Alternative.</p> <p>Dewatering system components would not fail as regularly due to corrosion.</p>

Summary

	No Pit Pond (No Action)	Partial Pit Backfill With In-Pit Collection (Proposed Action)	Partial Pit Backfill With Downgradient Collection	Underground Sump
Project Economics Issues				
Costs				
Reclamation costs	\$1,168,000	\$55,355,000	\$55,357,000	\$1,260,000